

rect, the concentrations of the two vapors are the coordinates of the location of the minimum on the error surface for that pair.

The validity of the single-vapor algorithm depends on the validity of the assumption that, of all the vapors of interest, only one is present at the time of measurement. This algorithm utilizes the following mathematical model of the response of a given sensor to a single vapor:

$$z = A(1 - e^{Bx}),$$

where z is the sensor response, x is the concentration of the vapor, and param-

eters A and B are obtained by least-squares best fit of sensor responses at known values of x . This model is appropriate because it gives both the expected zero response at zero concentration and saturation response at high concentration.

The first step of the single-vapor algorithm is to identify the vapor by applying standard statistical pattern-recognition techniques to the responses of the electronic nose. Assuming that the vapor has been correctly identified, one could, in principle, estimate the concentration by applying the inverse of the model to the responses of all sensors in the nose. The question is how

best to utilize the readings of all the sensors in the nose to obtain the best estimate. Research has answered the question: the best estimate is obtained by inverting the reading of a single sensor known to be best for the vapor that has been identified. Accordingly, the algorithm chooses the sensor found to be best for the identified vapor and calculates the concentration from the reading of that sensor.

This work was done by Rebecca Young of Kennedy Space Center and Bruce Linnell and Barbara Peterson of ASRC Aerospace. Further information is contained in a TSP (see page 1).

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Radiation-Tolerant Dual Data Bus

Dedicated hardware and software would detect radiation-induced upsets on either of two buses.

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An architecture, and a method of utilizing the architecture, have been proposed to enable error-free operation of a data bus that includes, and is connected to, commercial off-the-shelf (COTS) circuits and components that are inherently susceptible to single-event upsets [SEUs (bit flips caused by impinging high-energy particles and photons)]. The architecture and method are applicable, more specifically, to data-bus circuitry based on the Institute for Electrical and Electronics Engineers (IEEE) 1394b standard for a high-speed serial bus.

The architecture and method call for the use of two IEEE 1394b buses that nominally carry identical data signals. It

is assumed that at all times, at least one of the buses is "good" in the sense that it carries complete and correct data signals. Electronic hardware and software operating at each receiving location (node) along the bus would select the data arriving on the "good" bus while ignoring possibly corrupted data arriving on the other bus, which could be operating under latchup or an SEU including, possibly, a single-event functional interrupt (SEFI, an SEU that changes a control logic level, causing the affected circuit to enter an erroneous operational mode or logic state, the recovery from which must be effected through a power reset or other specified procedure).

The hardware at each node would include network-interface circuits plus special-purpose circuits denoted circumvention circuits. Among the circumvention circuits would be bus-management circuits and watchdog timers that would monitor the network interface chips. Use of software would examine the outputs of these circumvention monitoring circuits to detect SEUs (including SEFIs). Latchups in radiation-sensitive IEEE 1394b bus components would be detected by current-sensing circumvention circuits. Upon detection of an SEU (including an SEFI) or latchup, other circumvention circuits would restore correct operation by turning off, then turning back on, then reinitializing the affected bus circuitry, all within a predetermined, acceptably short time.

The software would reside in a dedicated radiation-hard microcontroller or shared radiation-hard single-board computer (SBC).

This work was done by Gary A. Kinstler of The Boeing Co. for Marshall Space Flight Center.

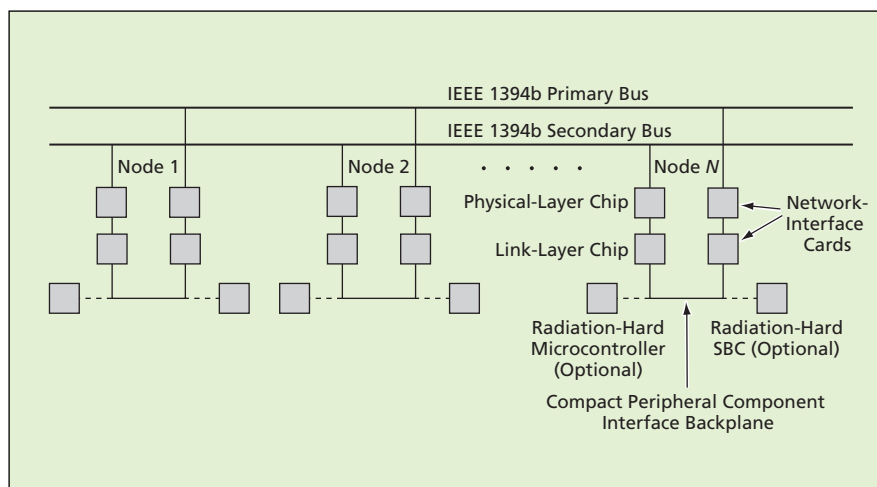
Title to this invention has been waived under the provisions of the National Aeronautics and Space Act {42 U.S.C. 2457(f)} to The Boeing Co. Inquiries concerning licenses for its commercial development should be addressed to:

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Two IEEE 1394b Buses would nominally carry identical data signals. The network interface circumvention circuits, with the help of the microcontrollers, would detect radiation-induced upsets on either bus.